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Attorney's Docket No.: 871-011683-US (PAR) *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail No.: EV 327674137 US
In re application of: SCOFET et al.
Serial No.: 0 /
Filed: Herewith
For: LOW COST OPTICAL MODULE

Group No.:

Examiner:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF CERTIFIED COPY

Attached please find the certified copy of the foreign application from which priority is claimed for this case:

Country	**: Great Britain**
Application Number	**: 0303526.8**
Filing Date	**: February 15, 2003**

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Joseph V. Gamberdell Jr

SIGNATURE OF ATTORNEY

Reg. No.: 44,695

Joseph V. Gamberdell

Type or print name of attorney

Tel. No.: (203) 259-1800

Perman & Green, LLP

P.O. Address

Customer No.: 2512

425 Post Road, Fairfield, CT 06824

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Newport
South Wales
NP10 8QQ

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Dated 19 March 2003

Patents Form 1/77

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NP10 8QQ

1. Your reference — 36030206 GB-01

2. Patent application number *(The Patent Office will fill in this part)* — 0303526.8

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Agilent Technologies, Inc.
- a Delaware corporation -
395 Page Mill Road
P.O. Box 10395
Palo Alto
CA 94303-0870
USA

Patents ADP number *(if you know it)* 07718680 01

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — Low Cost Optical Module

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Agilent Technologies UK Limited
Legal Department - IP Practice Group
Eskdale Road, Winnersh Triangle
Wokingham
Berkshire
RG41 5DZ

Patents ADP number *(if you know it)* 07718840 01

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
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Yes

Patents Form 1/77

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Continuation sheets of this form	
Description	5
Claim *(s)*	2
Abstract	1
Drawing *(s)*	6 + 6 sht

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date

Dr. James Patrick Lenney 14th February 2003

12. Name and daytime telephone number of person to contact in the United Kingdom: Pauline Jones 0118-927-4423

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Low Cost Optical Module

The present invention relates to a lost cost package for optical modules. More specifically, the present invention relates to a ceramic co-axial package for an optical module used in a high speed optical communication systems.

As seen in figure 1, currently optical modules 1, including transmitters, receivers and transceivers, are packaged in metal or ceramic boxes 5. Alignment between the optical fibre 16 disposed in V groove of a silicon optical bench 18 and an active optical element 14 is achieved using an active optical alignment process implemented during the assembly of the receiver module. The V groove fibre 16 is then coupled to a further fibre 10 located in a ferrule 12 attached to an aperture 7 at one end on the module.

As use of the Internet and optical fibre based communication increases, there is a growing need for faster transmission rate. Transmission rates of 10 Gb/s are becoming common and this is set to increase in the near future to 40 Gb/s and beyond.

In addition, there is a constant effort among network and communication system providers to drive down the cost of the systems, which means both component and transceiver module manufacturers must reduce the cost of their product in order to remain competitive.

An active alignment process in which the fibre is moved into position with respect to the active optical element while the element is powered is both labour intensive and time consuming, and thus expensive and not in-line with current industry efforts to reduce the cost of optical module packages.

The present invention aims to provide a low cost, passively aligned optical module package.

According to the present invention there is provided an optical module comprising an upper plate having an aperture, and a lower plate, said lower plate having at least one

active optical component disposed thereon at a predetermined height above upper surface of said lower plate, said module further comprising a ferrule disposed within said aperture, said ferrule extending through said aperture a predetermined distance so as to facilitate efficient optical coupling between said active optical component and a fibre disposed within said ferule.

While the principle advantage and features of the present invention have been described above, a greater understanding and appreciation of the invention may be obtained by referring to the drawings and detailed description of the preferred embodiment, presented by way of example only, in which;
Figure 2 shows the base plate with electrical tracks,
Figure 3 shows the base plate of figure 2 populated with components,
Figure 4 shows the cover plate with an aperture,
Figure 5 shows the cover plate of figure 4 with a ferrule attached,
Figure 6 shows the underside of the ferrule/cover plate assembly of figure 5,
Figure 7 shows the cover plate and base plate prior to assembly,
Figure 8 shows the module package assembly with a front optical connector and a rear electrical connector, and
Figure 9 shows an alternative electrical connection arrangement.

In figure 2 the base plate 20 is a substantially flat tile typically made of a ceramic material. The use of a ceramic material aids in the distribution of heat generated by any active components placed on the tile. Electrical tracks 22 are disposed on the surface 25 of the tile according to the specific needs of the module. As seen in figure 3, various components 24 are attached to the tile at predetermined locations. An active optical component 26 is also disposed on surface 25 of the tile at a predetermined location.

The components 24 and 26 can be mounted using epoxy or alternatively, ultrasonic bonding. Components 24 and 26 can be than be electrically connected to tracks 22 using wire-bonding methods.

Alternatively, "flip chip" bonding methods can be employed in which ultrasonic power is used to attach the component or chip to the tile, thus reducing the possibility of contamination to the internal components that often occurs when epoxy or soldering methods are used. With this method it is possible to mechanically attach the components and at the same time create the electrical connections without the use adhesives or solder and thus simplify the process.

In the embodiment shown here the optical module is a receiver module and the active optical component 26 is a detector. The detector may be a PIN type detector or avalanche photodiode (APD). The detector can be mounted using the "flip chip" method.

In a further embodiment, the optical module is a transmitter module and the active optical component 26 is a light source. The light source may be a laser. The laser may be a vertical cavity surface emitting (VCSEL) type laser. The laser can be mounted using the "flip chip" method.

In figure 4 the top plate 40 is shown having a centrally located aperture 42. The top plate can also be made from ceramic material or metal. As seen in figures 5 and 6, a ferrule 50 is disposed in the aperture 42. Ferrules are well known in the art as a means of holding optical fibres, which are typically disposed along a centrally located axis 52 of the ferrule.

The ferrule 50 is positioned within the aperture 42 so that it extends through the bottom surface 60 of the top plate 40 by a pre-determined distance. A fibre (not shown) is located along the central axis 52 of the ferrule. The end of the fibre is polished so that it is substantially parallel with the end face 62 of the ferrule. At the opposite end of the ferrule the end of the optical fibre may also be polished so that it is substantially parallel to end face 64 of the ferrule.

As seen in figure 7, the top plate 40 is positioned over bottom plate 20 and sealed together along the outer edges 48 and 28 of the plates. The seal is such that components

24 and detector 26 are protected from possible contamination by external sources. This typically means the package is hermetically sealed. The seal can be achieved using epoxy or soldering techniques.

The predetermined distance the ferrule protrudes through the aperture 42 and the accuracy to which the height of the detector 26 above the surface 25 of the base plate is known ensures that efficient butt coupling occurs between the fibre and detector. Thus the module can be aligned passively without requiring power of the active optical component, in this case the detector. This passive alignment method requires no additional coupling optics, such as lenses and mirrors and uses fewer steps during the assembly process and is thus less expensive than other know active coupling techniques.

The detector height can be controlled by using the flip chip mounting technique and by accurately knowing the thickness of the detector die.

The ferrules distance from the covering plate can be controlled during assembly by referring to marks located on the cover plate and/or by using accurate micro-positioning equipment.

As seen in figure 8, the sealed module package can now have further optical connectors 82 disposed over the ferrule to establish optical connection to the rest of the communication system. Furthermore, electrical connection can be achieved using an electrical connector 85 attached to the under surface 84 of the base plate 20. This electrical connector can be a flex connector.

Alternatively, as seen in figure 9, electrical leads 100 can be used to establish electrical connection between the receiver package 120 and a print circuit board 125. The spacing and thickness of these leads can be chosen to reduce RF leakage from the receiver package and leave extra space for other electrical service connections. The use of leads instead of pins ensures furthermore a more flexible mechanical connection to the PCB.

As will be appreciated further embodiments of the above invention are envisioned and covered within the scope of the claims.

Claims

1. An optical module comprising an upper plate (40) having an aperture (42), and a lower plate (20), said lower plate having at least one active optical component (26) disposed thereon at a predetermined height above upper surface (25) of said lower plate, said module further comprising a ferrule (50) disposed within said aperture, said ferrule extending through said aperture a predetermined distance so as to facilitate efficient optical coupling between said active optical component and a fibre disposed within said ferule.

2. A module as claimed in Claim 1, wherein said upper and/or lower plates are ceramic.

3. A module as claimed in any preceding Claim, wherein said active optical component is flip chip mounted on said upper surface (25) of said lower plate (20).

4. A module as claimed in any preceding Claim, wherein said active optical component (26) is a detector.

5. A module as claimed in Claim 4, wherein said detector is a PIN detector.

6. A module as claimed in Claim 4, wherein said detector is an avalanche detector.

7. A module as claimed in any preceding Claim, wherein said module is an optical receiver.

8. A module as claimed in Claims 1-3, wherein said active optical component (26) is a light source.

9. A module as claimed in Claim 8, wherein said light source is a laser.

10. A module as claimed in Claim 9, wherein said laser is a vertical cavity surface emitting laser.

11. A module as claimed in Claim 8-10, wherein said module is an optical transmitter.

12. A module as claimed in any preceding Claim, wherein said upper and lower plates are hermetically sealed.

13. A module as claimed in any preceding Claim, wherein said module further comprises an electrical connector (85) disposed on surface (84) of said lower plate (20).

14. A module as claimed in Claim 13, wherein said electrical connector (85) is a flex connector.

15. A module as claimed in Claim 13, wherein said electrical connector (85) is a series of electrical lead connectors (100).

Abstract

The present invention comprises an optical module having a ferrule disposed in an aperture in an upper plate of the module. The ferrule protrudes a predetermined distance through the aperture in order to facilitate butt coupling of an optical fibre to an active optical component disposed at a predetermined height on a lower plate of the module.

(Figure 8)

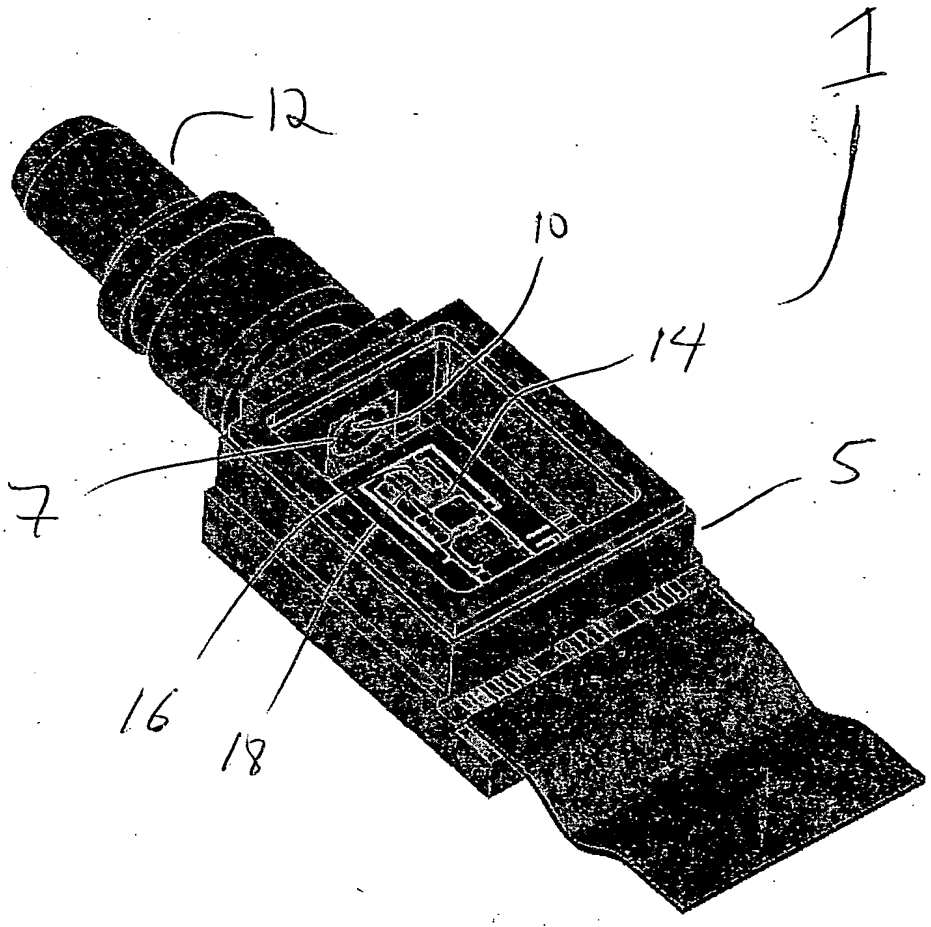


Figure 1

Prior Art

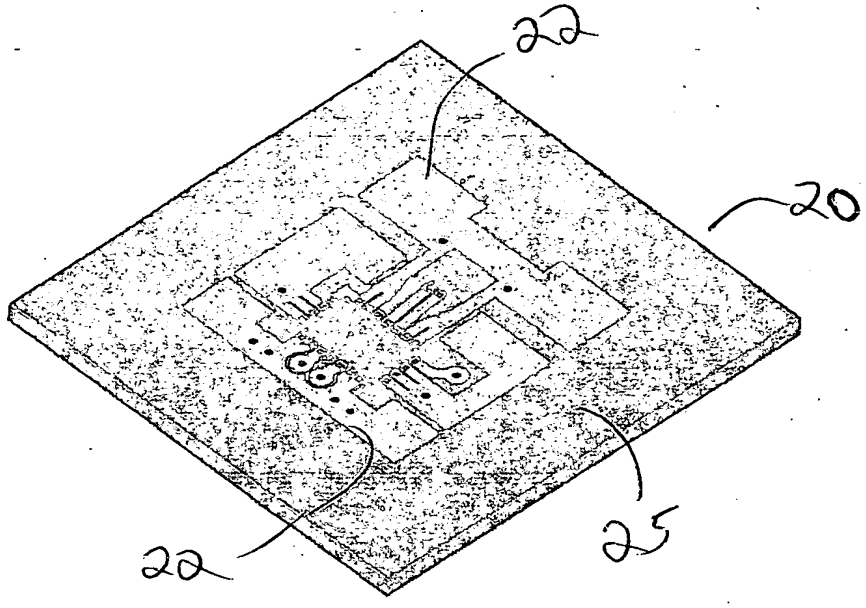


Fig 2

ceramic tile with electrical tracks

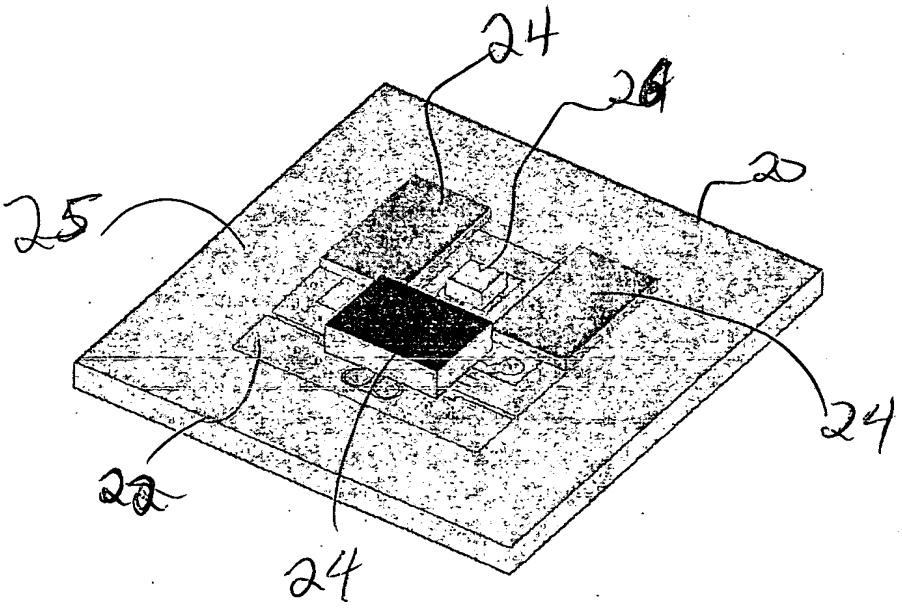
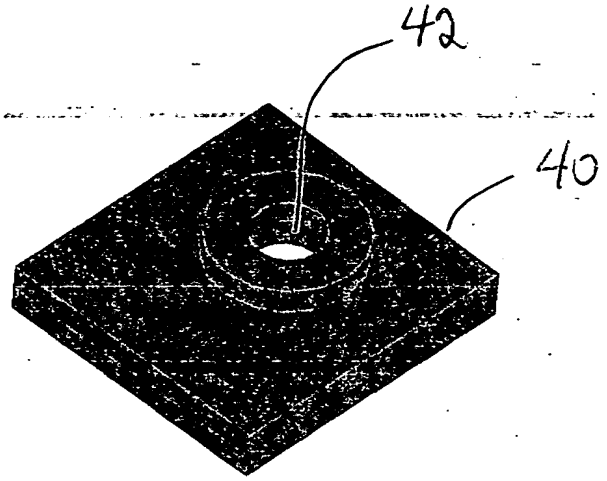


Fig 3

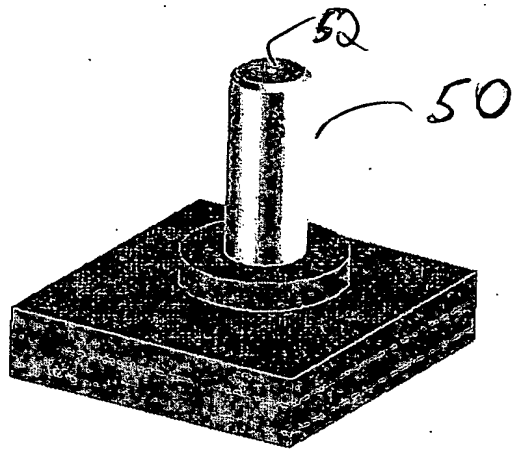
Components population and PIN height control

Fig 4



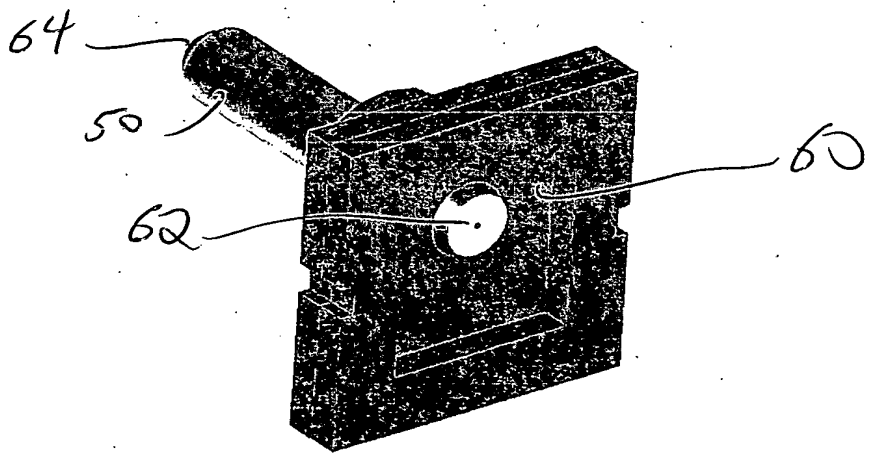
Ceramic cover with hole for ferule optimal positioning

Fig 5



Ferule attach to the cover with controlled height

Fig 6



Ferule protruding on the internal side at controlled height.

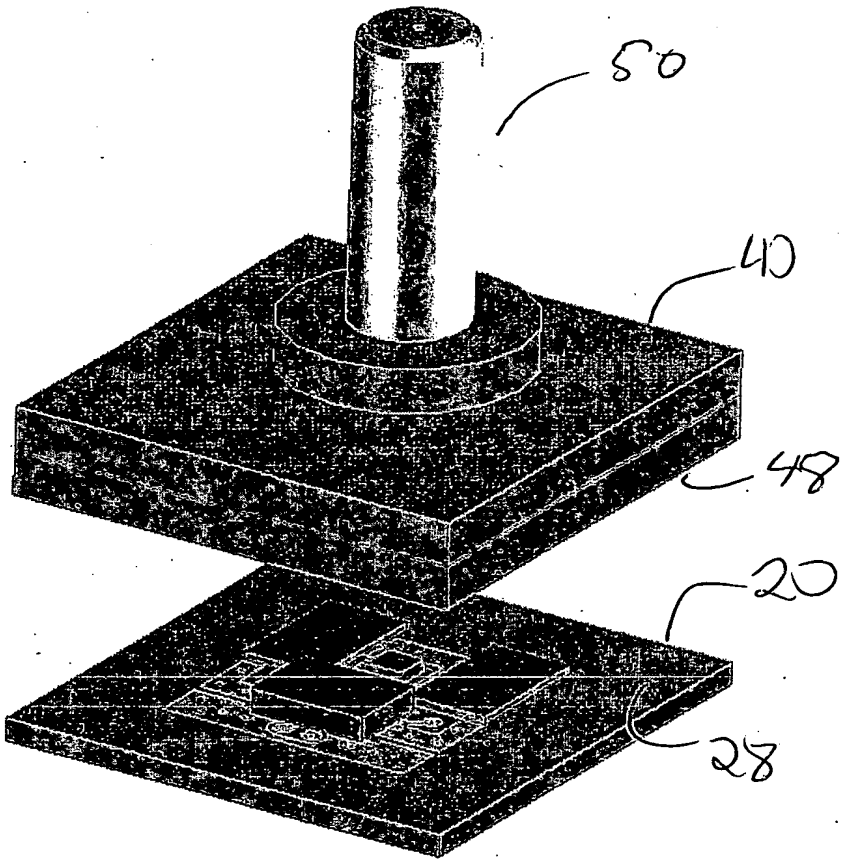


Fig 7

Simultaneous alignment and package closure

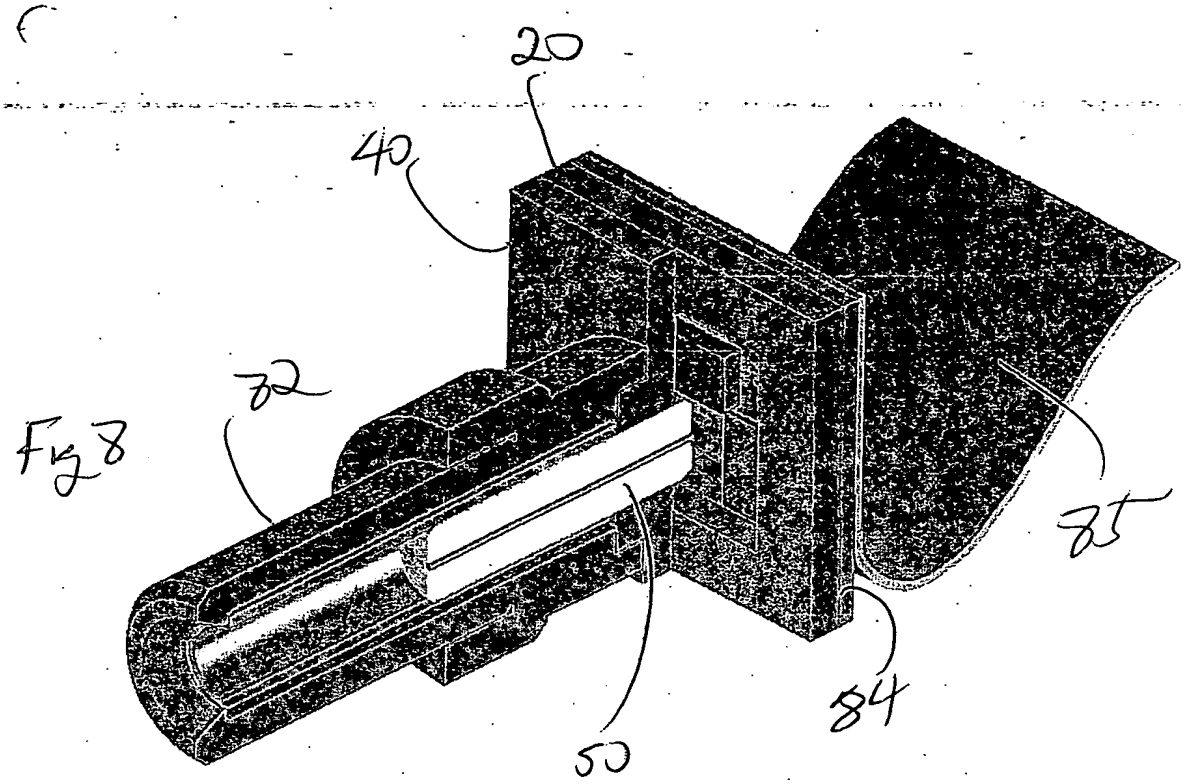


Fig 8

Front optical nose insertion for optical interface connection and rear flex attach for electrical connection

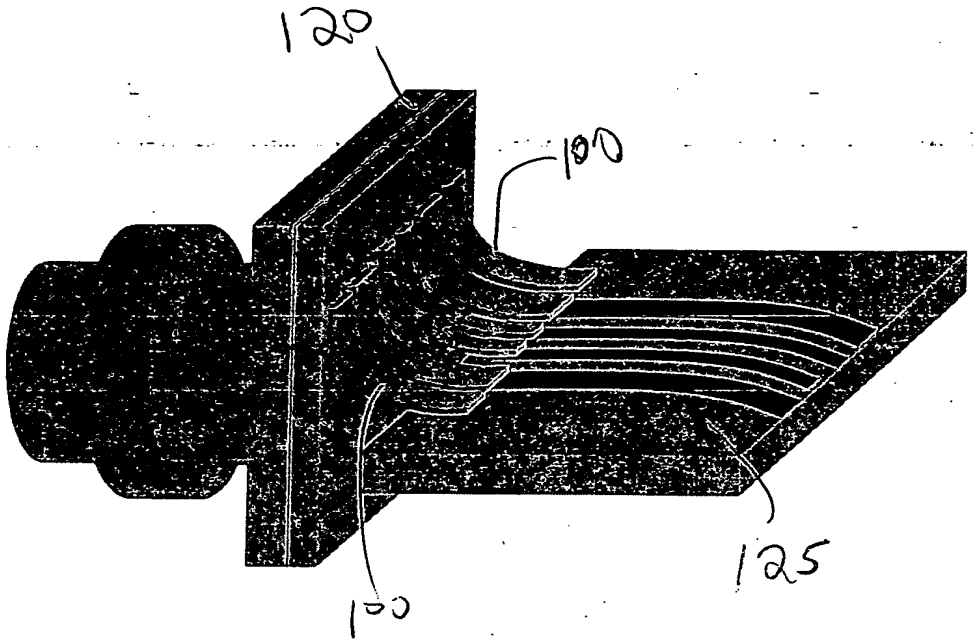


Fig 9

Shorter rear electrical connection with leads